The Future in Computer Graphics Education

Report from the joint Eurographics-SIGGRAPH workshop on Computer Graphics and Visualization Education (GVE’99)
Coimbra, Portugal, July 1999
The Future in Computer Graphics Education

Chair:
Michael B. McGrath

Panelists:
Werner Hansmann
Dena E. Eber
Judith R. Brown
José Carlos Teixeira
The Future in Computer Graphics Education

For further information see:

www.eg.org/WorkingGroups/GVE/GVE99

www.education.siggraph.org/conferences/GVE99
Computer Graphics in the CS Curriculum

Werner Hansmann

University of Hamburg, Germany

hansmann@informatik.uni-hamburg.de
Computer Graphics in the CS Curriculum

Overview

- Questions
- Recommendations
- Conclusions
Computer Graphics in the CS Curriculum

Questions

• How do we teach: top-down or bottom-up?
• At what level should we be teaching CG?
• What is the job market for our students?
• What skills should students have?
• What topics should be taught?
• What is the balance of lecture/reading/lab/projects?
• What is the role of collaboration?
Computer Graphics in the CS Curriculum

**How do we teach?**

- Trend towards top-down using high level API
  - *start with API*
  - *replace API pieces with students’ own details*
- Top-down first course can raise students’ motivation in a second course
At what level should we be teaching?

- 3rd year out of 4 year program of study
- Prerequisites:
  - *programming, algorithms, data structures*
  - *3D analytic geometry, linear algebra*
- Benefits for other CS courses:
  - *CG is a source of examples for motivation*
  - *solidifies knowledge of math and programming*
Computer Graphics in the CS Curriculum

What is the job market for our students?

- Scientific visualization
- Entertainment
- Web-based applications
- CAD / CAM
- Software companies developing graphics packages
- System development where general graphics skills or event-driven programming is required
What skills should students have?

- Communication / social / management skills
- Esthetic sensibility
- Technical skills (cf. topics)
- Ability to know how to learn: eg.
  - ability to acquire knowledge of a new system on their own
What topics should be taught?

- Rendering pipeline, coordinate systems
- Event-driven programming
- Basic geometric modeling, hierarchical modeling
- Introduction to color theory
- Physics of illumination, interaction of light and matter
- Hidden line / hidden surface removal, shading
- Simple animations and interaction
- Special course: Visualization
Computer Graphics in the CS Curriculum

What is the balance of lecture/reading/lab/projects?

- Lecturing method: use power of our medium, CG
- Present lecture on concepts and technical basis
- Lectures vs. labs and projects:
  - lectures must be general, as opposed to
  - different lab exercises for different categories of students
- CG textbooks should be reference texts
Computer Graphics in the CS Curriculum

**What is the role of collaboration?**

- Inter-disciplinary:
  - Arts
  - Animation
  - Engineering
  - Scientific visualization applications

- Group projects
Conclusions

- Rendering pipeline remains important
- 3 essential features of beginning CG course:
  - *CG is fundamentally 3D*
  - *a great deal of CG is interactive*
  - *CG is fundamentally visual*
- CG has rich potential as a capstone course
- Graduate CG education depends on institutions’ / instructors’ specialties
Areas of Concern

- Content
  - Overall Curriculum
  - Course Work
- Interdisciplinary Issues
- Teaching Issues
- Assessment
- Focus Areas
Overall Curriculum

- Span many disciplines
  - Computer science, film
  - Other academics
- Determine focus areas
  - General
  - Topic based
- Flexible evolving curriculum
CONTENT

**Course Work**

- Focus on creative and technical concepts
- Ground digital arts in history & theory
- Stress problem solving and resourcefulness
CONTENT

Course Work

• Group & individual communication skills

• Introduction course
  – Digital concepts
  – Variety of expression
Course Work

- Foundations
  - Include digital visual concepts as part of foundations for all
  - Require traditional foundations for all computer art students
- Time
  - Start computer art core as soon as possible
INTERDISCIPLINARY ISSUES

Foster Environments That Encourage:

- Dialogue
- Collaboration and common projects between
  - Departments
  - Disciplines
  - Cultures
  - Industry
TEACHING ISSUES

Critical Issues
- Limited resources
- Funding & technical support
- Teacher workload

Basic Competency
- Prior to college
- Provide course work for those without background
ASSESSMENT

Still Need to Develop

• Objective ways to measure
  – Student achievement
  – Departmental progress
• Internal and external evaluation
FOCUS AREAS

Disciplines in Digital Arts

• The still
  – Imaging, 3D modeling
• Time
  – Animation, video
• Interactivity
  – Interactive CDs, web
• Interdisciplinary (in art)
  – Photography, painting
The use of computers in the arts:

• Builds on artistic traditions
• Embraces new forms of creativity

Recommendations

• Encompass artistic & technical concepts, problem solving, expression, & collaboration in courses
• Balance art & technology
SUMMARY AND CONCLUSION

Technology will change, but good art fundamentals will not.
Computer Graphics for Teaching

Judith R. Brown
The University of Iowa
Computer Graphics for Teaching

Andres Iglesias
Computer Graphics for Teaching

**Issues**

- Finding what exists already
- Finding other educators
- Lack of recognition/rewards
- Difficulty measuring effectiveness
- Challenges understanding other disciplines/cultures
- Inadequate hardware/software/networks
Computer Graphics for Teaching

Recommendations

• SIGGRAPH/Eurographics portal of resources
• Work towards effective international communications
• Seek collaborations
  – multidisciplinary
  – multi-cultural
  – industrial
Computer Graphics for Teaching

Projects

- Compile list of current resources
- Review current and new resources
- Refereed journal on computer graphics and teaching
  - list existing publications with educational sections
Computer Graphics for Teaching

Projects

• Investigate tools for collaborating
  – interdisciplinary classes
  – joint classes across distance
  – students interacting globally

• Note importance of networks
  – local, national, international
Computer Graphics for Teaching

Iowa - Taiwan Collaboration

SI99RAPH
Los Angeles
Computer Graphics Courseware
José Carlos Teixeira
University of Coimbra - Portugal
teixeira@mat.uc.pt
Courseware Authoring Process

Produce courseware for better teaching and learning

- follow the technological developments
- support individual, online and more autonomous learning
  - learner model
  - distribution and interaction with the content
  - model the knowledge acquisition
Courseware Authoring Process

Assume a cooperative approach with different roles

- **teacher**: concept, pedagogic and didactic, assessment
- **artist**: graphics design
- **multimedia expert**: multimedia production
- **programmer**: simulations, ...

Don’t forget quality certification!
Courseware Authoring Process

Idea Generation

Didactic Review → Assessment Tests

Content Selection and Structure
- Source selection
- Evaluation
- Migration
- New material
- References -> Nodes

Multimedia Production

Programming Simulations

Design and Layout Creation

Feedback by the reviewers

Quality Verification Cycle

Delivery

Self tests given by the Students

Assessment Tests

Quality Verification Cycle
Cost of Courseware Production

High-quality courseware is very expensive

- 1 study hour could represent 100 hours of development!

Cost depends on:
- content
- media used
- use of templates
- reuse of previously developed material

Don’t forget the production management!
Our specification of media:

- mechanisms for the delivery of content to users
  - education, arts, entertainment, …
  - communication between humans and dissemination of information

Interactive media

- active participation of the users -> feedback

Multiplicity of devices and standards

- barrier to the creation and dissemination of media
Media

New frameworks for communication

- Web, interactive television, virtual environments, …

Knowledge to be acquired

- artists and technologists for media should have a good understanding of computer graphics, animation and image processing
Media

Design

• design criteria particular to each type of media
• visual design
• design of the process
• design of tools for media production

Quality

• choice of appropriate media to express the ideas
• economy in the use of media
Courseware use

Different issues for different types of courseware

- general-purpose courseware
  - *great pedagogic and didactic care*
  - *modularity to allow the use by large*
- specific courseware
  - *higher-level knowledge units*
  - *less modular*
  - *higher design and production costs*
Courseware Use

Re-use of course materials
- use of the same courseware modules in the production of different courseware entities

Multiple use of course materials
- use of the same courseware modules by many users

Do we really re-use course materials?

MODULARITY
Modularity

Separation of Content from Structure

- sequence is not mixed with content

Autonomous sequences

- basic structured courseware

Database Management

- indexing system
- management of versions
Co-operation SIGGRAPH-Eurographics

Digital Library
Educational Materials and Resources

Eurographics
Working Group on Education

SIGGRAPH Education Committee

Other Submissions

Eurographics
Conferences and Workshops

SIGGRAPH
Conferences and Workshops

IEEE
Computer Society

 REVIEW
Process
Courseware Issues

- encourage the implementation and use of courseware resource centres
- ensure confidence by quality control of the courseware available
- teach instructors and students to effectively use courseware
- improve international co-operation and networking to allow for an appropriate access to resources